

SCIENCE

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ILLUSTRATED.

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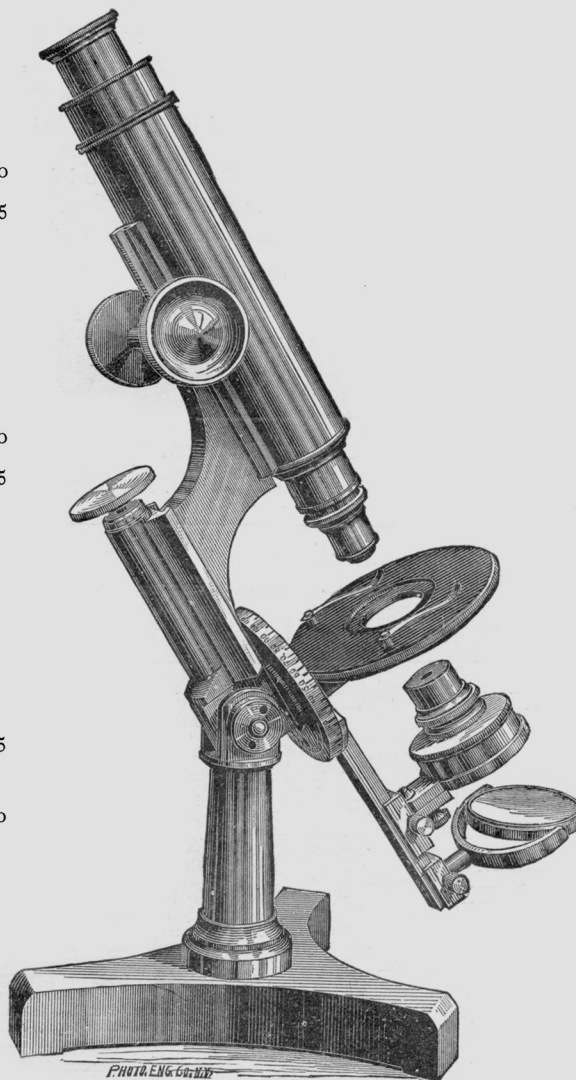
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JOHN MICHELS, Editor.

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NOTICE TO CORRESPONDENTS.

The writer of a paper "*On Ether*" will much oblige by forwarding his name and address.

THE DISCOVERY OF NEPTUNE.

The brilliant theoretical discovery of this planet by Leverrier and Adams, will be distinctly remembered by many of our readers. Soon after the publication of the mathematical investigation made by the two astronomers who had won so much glory, Professor Benjamin Pierce, of Harvard College, startled the scientific world by the announcement that after all this discovery was only a happy accident, and that the planet found by Galli, in accordance with the directions of Leverrier, was not the planet "to which geometrical analysis had directed the telescope." This statement by Professor Pierce has, we believe, found but little credence among European astronomers and mathematicians. Among those who were well qualified to judge, and who may be considered as free from national prejudice on this question, we mention Hansen, the well-known theoretical astronomer of Germany, and Jacobi, one of the ablest mathematicians of the same country; both of whom expressed the opinion that Professor Pierce was himself mistaken. In a posthumous book recently published on "Ideality in the Physical Sciences," edited by his son, Professor J. M. Pierce, the present professor of mathematics in Harvard University, Professor Pierce reiterates his former opinion on the discovery of Neptune. It appears that a few years before his death he had made a careful review of his former investigations, and says, p. 173: "I strictly adhere to the correctness of my early statement." This opinion seems to be shared also by Professor J. M. Pierce, who says, p. 201 of the Appendix: "It is to be regretted that the

correction of the error was not received, on the part of the French astronomer, with the magnanimity and fairness which it is always painful not to find associated with high intellectual power."

Intrinsically, the question raised by Professor Pierce is an interesting one, and the whole matter seems to us worthy of a new and careful discussion. It may well be doubted whether the argument used by Professor Pierce, that there is a change in the character of the perturbations near the distance of 35.3, will apply to the method employed by Leverrier and Adams in their discussion of the perturbations of Uranus. This method is so interesting that we invite the attention of students of theoretical astronomy to this question, which seems to us capable of a complete and definitive mathematical solution.

VIVISECTION.

Dr. Darwin in a letter to a friend has expressed his views upon vivisection. He writes:

"I know that Physiology cannot possibly progress except by means of experiments on living animals, and I feel the deepest conviction that he who retards the progress of Physiology commits a crime against mankind. Anyone who remembers, as I can, the state of this science half a century ago must admit that it has made immense progress, and is now progressing at an ever-increasing rate. What improvements in medical practice may be directly attributed to physiological research is a question which can be properly discussed only by those physiologists and medical practitioners who have studied the history of these subjects; but so far as I can learn, the benefits are already very great. No one, unless he is grossly ignorant of what Science has done for mankind, can entertain any doubt of the incalculable benefits which will be derived from Physiology, not only by man, but by the lower animals."

PROBABLE BRANCHIAL ORIGIN OF THE THYROID AND THYMUS GLANDS.

BY S. V. CLEVINGER, M.D.

There are many reasons for believing that the thyroid and thymus are rudimentary gills, one of the main objections to the view being the structure of these bodies, but in the light of modern biology, structure is almost meaningless in homologizing, besides, the tissues of these parts are not the same in all animals. Owen (Vol. I. p. 565) says the thymus appears in Vertebrates with the establishment of lungs as the main or exclusive respiratory organ. In Siren and Proteus the thymus is wanting, as in all fishes. Gegenbaur (p. 554) speaks of the thyroid as an organ with unknown physiological relations, and that "in fishes it is placed not far from the point at which it was formed, that is, at the anterior end of the trunk of the branchial anterior and between it and the copula of the hyoid arch. In amphibia near the larynx, and is set on the inner surface of the posterior cornua of the hyoid." Gegenbaur considers it as an organ of use among *Tunicata*. This latter idea, as well as the one I have advanced, needs verification. I am unwilling to devote more time to the subject until I can ascertain whether some one has not preceded me in announcing the homology, if it be really one. Much light can be thrown upon the disease known as Goitre by clearing up this point.

THE ADDRESS OF THE PRESIDENT OF THE ROYAL MICROSCOPICAL SOCIETY.

LIONEL S. BEALE, F. R. S.

As it is usual on this occasion for the President to deliver an address, I venture to offer for your consideration this evening some suggestions in connection with a subject which in one or other of its aspects must needs be of great interest to every one who wishes to learn all he can about the wonderful changes which continually go on in all living things, some being within and some beyond the present limit of scientific investigation; and though I shall express some views with which perhaps many here will not agree, I trust my remarks may kindle interest and encourage discussion, rather than offend. Where wrong I shall be glad to be corrected, but I claim permission to speak freely what I think, and liberty to advance my conclusions, which, though not at present very popular, may yet be worthy of your consideration.

THE MICROSCOPIC LIMIT, AND BEYOND.

Increased skill and ever-extending knowledge may enable the scientific worker not only to reach the utmost limit of inquiry in his time, but possibly to gratify that constant desire to see into the limitless region which lies beyond the bounds of actual investigation. This is the hope which encourages the thoughtful observer; for who would not consent to spend years in patient research, if by so doing he could succeed, as it were, in projecting his intellect, were it ever so short a distance, beyond the circumscribed region in which the senses can alone operate? Failures and disappointments may be endured if only the observer's mind be buoyed up by the hope that ere his nerve-tissues grow too old, and begin to fail, the longing of his intellect will probably be gratified. To many, indeed, who are unable or unwilling to look into the secrets of nature, such hopes and desires will seem unintelligible or incredible. They will be regarded as the idle fancies of an idle mind; and the ardent scientific inquirer will be pitied or condemned as a weak, foolish person who, like a child, is unable to repress his morbid curiosity to peer into the unseen, and his craving to know the unknowable;—as one deserving to be classed with simpletons and madmen, on the ground that it is absurd to suppose that a really sensible person would spend his life in hard work without remuneration, in preference to doing that which would enable him to gain wealth, and to live at ease, if not in luxury and enjoyment. And certainly it must be confessed that in few departments of research is there less prospect of gaining by success such rewards as are generally sought for, than in the one to which we are attached.

The microscopist, like the astronomer, is ever longing to get a little beyond the point at which he has already arrived. Each new fact gained by research seems but to indicate the existence of more and more important things beyond. Limit is reached and then surmounted, but soon a new limit seems to rise from the mists in the distance, towards which the worker is impelled by new hopes and desires. It is this never halting progress which distinguishes scientific from every other kind of inquiry, and particularly microscopical investigation, for it can never be completed. It deals with the illimitable. The boundaries of to-day are found to have vanished to-morrow, and the eyes and understanding begin to penetrate into regions which but a short time before had been considered far beyond the range of possible investigation.

He only who was quite ignorant of the many and great improvements constantly being made in our methods of research, and in the instruments required in investigation, would think of fixing any limit to the advance of microscopical inquiry. The records of the work of this Society contain many examples of progress towards and advance

beyond barriers regarded not very long before, and by considerable authorities, as insurmountable. I well remember the time when in many branches of inquiry, it might have been truly said that the optical instrument was in advance of the methods of examination; when our magnifying powers were higher than we could use without losing rather than gaining as regards the definition of delicate structure. As, however, time went on, this was changed. New and improved methods of examining tissues were discovered, and means adopted, by which excessively thin layers could be submitted to examination, and a power of five or six hundred diametres was no longer sufficient to enable the observer to see all that it was almost certain was to be seen. These remarks more particularly apply to a class of researches upon which I was engaged in 1856-60, concerning the structure and arrangement of the ultimate nerve-fibres in various tissues and organs. Indeed, I feel quite sure that at and before that time advance was actually retarded by the discouragement offered in some quarters, and the hypothetical objections raised to the use of very high powers, and more especially to the methods of preparation of the tissues that were necessary before they could with any advantage be submitted to examination.

Although at this time we can work easily with a twelfth and a twenty-fifth, the results of observation conducted with the aid of such powers are still regarded by some with doubt and incredulity; and if we draw attention to actual structure and arrangement discovered by the higher powers, which could not possibly be demonstrated with the aid of a more moderate lens, our statements may possibly be met with insinuations that what was advanced as the result of observation was, after all, discovered by the imagination only.

Our present limit of observation in investigations on the structure and action of the tissues of man and the higher animals, in my opinion, includes the use of magnifying powers of upwards of 2000 diameters. Objects considerably less than the hundred-thousandth of an inch in diameter can be studied with success, but how much less than these dimensions cannot, I think, be determined with accuracy at this time; for so much depends upon the character of the object, and a number of small points of detail as regards the mode of examination. All who are accustomed to work with high magnifying powers are well aware of the great advantages gained by some very slight change in the degree of illuminating power, the direction and concentration of the rays of light, and very slight and happy alterations in the focus, which may momentarily reveal to the mind new facts of the greatest importance after, perhaps, many hours of careful but almost profitless study.

But in other departments of microscopical research, our present means of investigation enable those familiar with the requisite methods of inquiry to demonstrate characteristics of structure far more intricate and minute than the remarks just made would lead you to infer. Various modifications in immersion lenses and in immersion media have greatly contributed to advance our knowledge of structure and action in the lower forms of life; and there is every reason to think that, as time goes on, methods of observation will be still improved and new methods discovered, and that in consequence conclusions already arrived at will have to be greatly modified or entirely changed. Not only so, but by the aid of photography things dimly seen by the eye may be very distinctly and correctly delineated, and with a perfection of accurate detail which a few years ago we should not have supposed to be possible. In all probability, the application of photography to investigations upon minute structural details will be carried far beyond anything yet reached, although it is really wonderful how much has been achieved up to this time.

As regards direct observation, with the aid of very high magnifying powers, upon animal tissues, a department of

microscopical work which has engaged much of my attention during many years, I would remark that many observations have been made upon the structure and arrangement of the most delicate nerve-fibres less than the hundred-thousandth of an inch in diameter, and other tissue-elements of very small insects. With due care, facts are ascertained which could not have been demonstrated with the aid of object-glasses magnifying less than from 2500 to 3000 diameters. Not only is the demonstration of structure and arrangement satisfactory, but in many cases a conception of the action and working of the textures during life has been formed, which would not otherwise have been obtained. The exact relation of certain delicate nerve-fibres to the living matter of the nerve in special organs has been determined, and many elementary facts necessary for the determination of the changes constituting nerve action have been ascertained.

To my mind, however, the study, with the aid of high powers and various improved means of examination, of the phenomena which occur in living matter during life, transcends in importance at this time all other inquiries in which the Microscope takes a leading part. For these changes characterize every form of living matter at every period of its being, and in every condition of health and disease. In every form of living matter which exists or has ever existed, the great mystery of life and death is enacted under our very eyes, but we have not yet been able to discover the exact nature of the change, though we can prove most conclusively that it is not merely mechanical or chemical, as some pertinaciously insist. No chemist or physicist has been able to explain the changes which do occur, or has succeeded in imitating them out of the living body. The most diverse structures and the most widely different chemical compounds are produced by changes occurring in particles of living matter which could not be distinguished from one another, and which are equally devoid of color and structure. Many of the current theories on the nature of vital phenomena are in advance of some that were propounded two thousand years ago; and yet men occupying high scientific positions are found to defend them, and to repeat again and again statements concerning the relation between the living and non-living, which are at variance, not only with facts familiar to every one, but are contradicted by the experience and knowledge every person possesses concerning certain vital phenomena of his own organism.

When a particle of living matter is increasing in size—is growing by taking lifeless matter into its substance, and without itself losing anything, is communicating to certain of the elements of this non-living matter, or to combinations of these, the marvellous powers it possesses—movements take place, it may be in every part of the original mass. These movements are, however, always most observable, most active, and most extensive at some part of the circumference. Occurring now on one side, now on the opposite, it is very improbable that the movements in question are determined by any changes occurring in, or by force belonging to, any non-living matter in the vicinity of the living mass. These remarkable movements are universal in the world of life. They are more accelerated in some kinds of living matter than in others, but they are present in all, and in most are discernible at some time or other during the course of existence. Parts of the living matter continually tend to move away and separate from the rest, not in consequence of any attraction between these and surrounding matters outside, nor from any repelling influence exerted by parts of the mass itself upon other parts. There seems to be an active tendency on the part of different portions of a living mass to move away from the rest and so to detach themselves, and, having acquired vital power, to become independent, and to increase and then divide. This remarkable tendency on the part of every kind of living matter to divide and subdivide begins to

operate as soon as the original mass has attained a certain size, and it seems to increase in intensity as the living matter approaches its proper dimensions. Invariably when a certain size has been reached, which, however, is different for different kinds of living matter, division occurs. The size is always, within certain very moderate limits, fixed and definite for the living matter of each particular species of living being. Among the lowest forms of existence, however, no definite limit of size has to be attained before division can occur. Particles smaller than the smallest particles that can be seen with the aid of the highest magnifying powers freely divide and subdivide, and there is reason to think that under certain conditions the division and infinite multiplication of the animate particles may continue for a considerable time, none of them attaining their fully developed form or dimensions. In higher forms of life, premature division of a living mass before it has grown for a proper time and reached a certain size, is very detrimental, and in many cases disastrous; for it is associated with degradation or even complete loss of formative, constructive, and developmental power. In some cases, by the rapid multiplication and division of the particles, the well being of the whole organism is jeopardized, and death may be occasioned by the changes brought about by great increase and rapid growth and multiplication of certain particles of living matter belonging to the blood or to some of the tissues.

When a portion of a mass of living matter moves away from the rest, the moving portion invariably presents a convex surface, of which the portion in the exact centre is of course in advance of the rest and is the point towards which the movement of adjacent portions tends. It almost seems as if one minute portion had moved away from the rest and had dragged with it neighboring portions, the power of the particles constituting which was not strong enough to act in opposition to it or to resist its influence. These seem to yield and follow the one or few particles in which the movement is strongest, and which seem to act the part of leader. It may be that certain particles here and there, having attained a larger size, or from being more active than the rest, move forward and determine the direction which is to be taken by those near. As far as can be seen, multitudes of living particles stream in one direction, the greater number being either carried along by the very few or irresistibly drawn onwards by them. The direction taken by flocks of birds and clouds of insects in still air or upon the surface of smooth ground, and shoals of fishes in water, is evidently determined and often very quickly changed in obedience to impulses affecting a very few of the great multitude of individuals of which the whole body is composed. These movements cannot, however, correctly be compared with those of a mass of living matter, inasmuch as there is no reason whatever for supposing that, in the latter, one particle has the power of choosing and determining, much less of conveying to its neighbors the results of its decision or choice and the request to follow.

It will, of course, be said by some that the remarkable phenomena we are considering are comparable with the movements occurring among iron filings under the influence of the magnet, or with the Brush discharge of electricity, the movements of the streams of highly attenuated moving matter in vacuum tubes, and other changes in place affecting particles of non-living matter. Surely it must be obvious to any one who thinks over the facts of the case that no true analogy has been shown to exist between the movements of living particles and those of any form of non-living matter. Nevertheless, the existence of such analogy is still maintained by a few, although the fallacy of the arguments upon which it is supposed to rest has been many times pointed out.

I dare say that for some time to come it will be most difficult to get a hearing for any views not in accord with the

materialist tendencies of what is miscalled the *science* of our time. Thought is to be crushed, and any speculations are to be condemned which do not happen to favor the arbitrary dogmas of the purely physical school. But no doubt these attempts, like preceding ones of the same order made at different periods of history—although they may succeed for a time, and by them people may be driven away from the truth—will ere long be given up. They may be safely left to the gradual process of disintegration and ultimate dissipation by which these and such-like fancies of physical ingenuity will be disposed of.

As I have shown elsewhere, whenever tissue and other matters peculiar to living beings are to be formed, living matter undergoes change. In fact, the act of forming these things corresponds with the cessation of life in the particles.

Let us now consider the probable nature of the marvellous forces or powers which operate upon the material of the living matter, and determine the relations to one another of the elements or collections of elements of which it consists. By the relations established between the elements shortly before living matter dies, will depend the properties and composition of the resulting formed substances. The changes in each particular kind of living matter are somewhat different, but peculiar to and characteristic of that particular kind, and as regards it, constant and uniform. But no differences in the chemical composition or in any physical characters to be shown in different kinds of living matter, will in any way account for or explain the differences so remarkable in the formed material which is produced by or results from the death of the living matter. Nor do any properties of the particles yet discovered enable us to suggest a plausible physical hypothesis to account for the facts.

All those peculiarities in form, structure, and properties of tissue, which characterize the multitudinous forms of life around us, and which enable us to distinguish them from one another, are imposed upon the matter of the moment when it passes from the living to the formed state, or succeed as the result of a long series of changes then initiated. These peculiarities are not found in any ordinary matter, and can only be accounted for on the supposition that some force, property, or power exists which is peculiar and belongs to the matter only while its life lasts. This exerts but a temporary influence on the material particles, which are by it constrained to take up such prearranged positions with respect to one another as must necessarily result in the formation of definite compounds. To this prearranged disposition of the atoms of matter must every character of formed material and every distinctive property of tissue be traced back. This is, indeed, the cause of the varying form, structure, and property of every tissue and every living form in nature. The instant the influence of vital power in restraining the combination of atoms, ceases to be exerted, definite compounds are formed, but these are not living. The matter of which they consist has ceased to live. There are no phenomena occurring in non-living matter in any way comparable with these vital phenomena. Scientific opinion on these matters has lately been unduly influenced by a materialist party, which, like a political caucus, has assumed the right to direct thought and to promulgate the particular dogma which alone is to be accepted by the faithful.

If now I permit myself to pass beyond the point to which I have been led by actual observation,—if I try to advance beyond the present microscopic limit, travelling as it were upon the same lines as when observing within it, and try to realize the phenomena which occur during the early period of development of some comparatively simple vegetable tissue, a leaf for example,—I think the following description will not be far from the truth: A mass of living matter, endowed with special powers working under certain definite conditions, takes up cer-

tain materials and increases in size thereby. Imparting to the new matter its powers, unweakened in force, as it grows, it soon divides into several portions, each of which in like manner grows and divides. The arrangement of the several masses, though fixed within certain limits, is determined not by any forces, powers, attractions, or repulsions acting upon all of them, but simply by the rate of growth of each, and division of the several masses under then existing external conditions; the dimensions each was to attain, as well as its properties, composition, color and the like being due to the life, force, or power each separate mass derived from the parental one which gave it origin, and from which it had been detached. But while the above phenomena are proceeding, changes are also occurring on the surface of each mass. The living matter in this situation, whether from the particles first formed, and being therefore the oldest, reaching the surface, and coming to the end of their living existence, or from some other cause I cannot say—passes out of the living state, and the component particles or certain of them combine, assume a certain form, and acquire physical properties they never possessed before. The formed material thus produced owes its colour, chemical composition, physical characters, internal structure, and the like, to the vital force or property in obedience to which the elements of the matter were made to occupy such positions and assume such relations with respect to one another just before death as must ensure the formation of the particular substances which result.

From the moment when the formation of the formed material occurred, the relative position of the several masses probably altered little. Growth may no doubt take place in certain directions by outgrowths, but none of the elementary parts with its surrounding formed non-living material cannot move from its place and get before or above any of its neighbors, as must at least be held to have been possible up to the time when its movements were restricted by the formed substances on its surface.

I would here remark generally, that if very little non-living matter is associated with the living matter, the latter may move in any direction with equal facility, and one part of a mass may place itself above or in advance of another portion just as easily as it could descend below it. But when a layer of formed material has been produced on the surface of the living matter, the entire elementary part becomes subject to gravitation in consequence of the quantity of non-living matter that is formed.

There is not, I think, any good reason for accepting the conclusion that one of a collection of elementary parts, at any period of development, can sympathize or otherwise influence the actions of others, as Virchow seems to think. The suggestion that any force or power acting, as it were, from a centre, governs, regulates, and determines the changes taking place in surrounding and more or less distant particles, is, in my opinion, inadmissible. We might, with as much show of reason, refer the harmonious action of the several parts of the adult organism to some controlling or governing power situated we know not where, influencing, we know not how, actions of many different kinds occurring at considerable distances from the seat of its existence. Although very high authorities have given their sanction to views of the kind, and have advocated the existence in connection with each individual organism of some power or force capable of operating through material of even considerable thickness and of controlling matter at a distance, I venture to assert that the conclusions are not supported by the results of observation and experiment. The idea of one particle of living matter influencing other particles at a distance from it, much less sympathizing with or being affected by vital changes occurring in them, cannot, I think, be entertained by any one who has studied the phenomena as they occur in living beings.

One can indeed conceive tissues of the most elaborate character, and new matter of the most wonderful properties and most complex composition, being developed in the most regular and orderly manner without supposing that any governing or controlling power acts upon them at all, as it were, from a centre. That the most wonderful order is manifest in the arrangement of the component elementary parts, say, of a growing leaf, must be obvious to every one who has ever examined it; but I feel confident that as soon as each living particle has been detached from the mass which preceded, it is no longer influenced by the latter, and does not influence neighboring masses. Each may be pressed upon by its neighbors, and press upon them in turn during growth, but there is no reason to suppose that any one determines the composition, governs the motion, or regulates the action of others. The nutrient matter is distributed to all by vessels or channels running amongst the several collections. Those elementary parts farthest from the nutrient supply will grow more slowly than those nearest to it, but no formative or constructive or synthetic or analytic influence is exerted by the nutrient fluid upon the living matter, nor by the several elementary parts upon one another. Each is under the influence of the vital power associated with the matter of which it in part consists; and whether each can exist independently if separated from its neighbors, or dies soon after it is detached, depends not upon any influence exerted upon it by those neighbors, but simply upon the inherent capabilities of its own vital power, transmitted to it from the living matter which existed before it, and of which it once formed a part.

Nevertheless, each individual elementary part, say, of a leaf, or other organ or tissue, must not in any case be regarded as an individual, independent, or self-dependent organism, for it constitutes but a part of a highly complex whole which has been gradually formed in accordance with a definite structural plan and arrangement, foreseen and prepared for as it were from the very first.

It is only by attributing the observed phenomena to the operation of a special force or power, having no analogy whatever with any known inorganic forces or powers, that a reasonable explanation of the facts can be framed. The phenomena which have been referred to cannot correctly be compared to any processes or actions which occur independently of life, neither can any true analogy be pointed out between these and any physical or chemical changes or actions of which we have at this time any knowledge or experience. That the formation of all tissues and organs is governed by "law" is no doubt true, but the "law" is unknown, and whatever may be its terms, the mode of its operation upon matter is as different from that of any laws that are known to operate in the non-living, as are the known and observed facts of life from those of the inorganic matter of the world.

Now as regards the nature of the actual phenomena of living matter which are at present beyond the range of observation, at least two diametrically opposite ideas are entertained.

1. There is the commonplace notion that structure exists which will account for the actions which take place, but that the details of this supposed structure are too minute or too delicate to be demonstrated by any magnifying powers which have yet been constructed. For this idea there is no sufficient justification. It is one of those assumptions in elaborating which the modern materialist is so ingenious. In this way he struggles, and with some success, to postpone for a time the inevitable fall of the system he has endeavored to make popular in spite of the overwhelming evidence of facts against it. Here I must remark that the word "structure" as employed by physicists is used in a sense utterly distinct from that in which we use the word. This is evident enough if we consider what is understood by the "structure" of a crystal and

the "structure" of an organ or tissue. The first "structure" at once disappears when the crystal is dissolved and reappears whenever it is formed. The other structure results, or, as some say, is evolved, only after many series of changes of a very complex character have been completed. Once destroyed, the structure of an organism can only be restored by a long course of similar developmental processes. In fact, there is not the faintest analogy between the structure of an organism and the structure of a stone—the structure due to the operation of living forces and the structure which is inherent with other properties in non-living matter.

2. There is the view supported by myself, and in favor of which I have adduced evidence which I believe to be perfectly convincing, that living matter has no definite structure whatever—that, in fact, its particles, and very probably their constituent atoms, are in a state of very active movement, which renders structure and fixity of arrangement impossible—this active movement being an essential condition of the living state, which latter ceases when the movement comes to a standstill. According to this view the idea of structure as belonging to living matter is inconceivable.

Now we know of no state in which non-living matter exhibits any analogy with matter in the living state, so that the cause of the state under consideration must have reference to the living state, and to that only; and to reassert, as many continue to do, that the phenomena manifested by living matter are to be accounted for by the properties of the material particles, is silly and perverse; and though the view of the peculiar nature of the vital power here put forward and based upon a consideration of the phenomena of living matter, may be ridiculed by materialists, every one who thinks over the matter will see at once why this course is taken by them.

Professor Huxley, in his article "Biology," in the "Encyclopædia Britannica"—without defining what he means by the words "molecular" and "machine"—assures his readers that "a mass of living protoplasm is simply a molecular machine of great complexity, the total results of the working of which, or its vital phenomena, depend, on the one hand, upon its construction, and, on the other, upon the energy supplied to it; and to speak of vitality as anything but the name of a series of operations, is as if one should talk of the 'horology' of a clock."* This is the sort of teaching that has long retarded the progress of thought, and affords an example of the puerile objections palmed off on the public as scientific criticism, and supposed to be sufficient to controvert evidence founded upon observation, and arguments based on facts which any one may demonstrate. Is it not most wonderful that Professor Huxley can persuade himself that a single reader of intelligence will fail to see the absurdity of the comparison he institutes between the invisible, undemonstrable, undiscovered "machinery" of his supposititious "molecular machine" and the actual visible works of the actual clock, which any one can see and handle, and stop and cause to go on again?

Magnify living matter as we may, nothing can be demonstrated but an extremely delicate, transparent, apparently semi-fluid substance. But observations on some specimens under certain advantages of illumination, and with the aid of the very highest magnifying power that can be brought to bear, favor the conclusion that living matter should be regarded as consisting of infinite numbers of infinitely minute particles, varying much in size, and possibly capable of coalescing, free to move amongst one another, as they exist surrounded by a fluid medium which contains the materials in solution for their nutrition, and other substances. †

[To be concluded in our next issue.]

* Huxley, Article "Biology," *Encyc. Brit.*

† From the *Journal of the R. M. S.*

TRICHINÆ IN MEAT.

A short time ago the public was greatly excited over the introduction into France of trichinated meat. It is remembered that the first case of trichina was noticed at Lyons on provisions exported from America. As regards the importance of this question, it is sufficient to state that, according to official documents, the importations of salt pork and of lard amounted in 1880 to 46,164,000 kilogrammes, of which 37,102,000 kilos. came from the United States. The prefecture of police ordered the inspectors of slaughter houses to examine all the incoming specimens of salt and smoked pork in the different stations and especially that of Batignolles. This station received indeed all the envoys of Havre, where four-fifths of American imports are disembarked. Unfortunately there was a great disproportion between the service of inspection and the continually increasing extent of the provisions. The result was an encumbering of provisions suspected of being contaminated at the points where the inspection took place. A certain number of merchants, moreover, desirous of entering into the possession of their merchandise, so as not to retard its delivery, have sought to evade inspection, and in order to obtain this end took advantage of the small number of inspectors, who, being grouped at certain points, thus allowed certain entries to be free from all verification; they have accordingly introduced their merchandise at these points.

The administration should put an end to this invasion. The Secretary-general of the police departments, anxious for the public health and its interests has, in concert with the Prefect of police, taken opportune measures and charged the municipal Laboratory to investigate the trichinated provisions that have passed the ports. The officers of the Laboratory, accompanied by a commissary of police, proceeded to those accused of introducing un-inspected provisions. Microscopic examination has in several cases shown the presence of trichinæ. We have, therefore, thought it useful to demonstrate the procedure, very simple, which is pursued in the investigation of this infection.

A specimen is taken from the muscular portion, and as much as possible in the vicinity of the bone or tendons, which is very easily accomplished by means of the instrument represented in figure 1. A small fragment of meat is



FIG. 1.—INSTRUMENT FOR EXTRACTING SPECIMENS OF MEAT, AND ITS SHEATH.

cut with a scissors from the fibres, and stretched on a plate of glass. A drop of diluted alcohol is added or some potassa, and the preparation is levelled by covering it with a lamina of glass (fig. 2); then placed on the stage of the microscope. A magnification of 70 diameters is sufficient for seeing the trichina quite distinctly. It is preferable, nevertheless, in order to work more rapidly and to distinguish the trichinæ of the striated muscular fibres, to magnify it 140 diameters.

Fig. 3 represents one of these preparations seen under the microscope; two trichinæ are enclosed in their cyst and the third has free movement over the muscular tissue.

The parasites that are met with on the trichinated meats of America are not dead, as is proved by the following experiments. A cut is made in the trichinated meat; distilled water is used instead of alcohol, and we begin our search for a free trichina. The preparation is then placed upon Ranvier's hot platinum, and the temperature is raised to 40° C. At the end of a certain time, displacements of the trichina will be observed. These movements become stronger from 42° C. to 45° C, and at 50° C. the animal dies.

The municipal laboratory, in employing this very simple mode of investigation has, as we have mentioned, been able to detect contaminated provisions in Paris, and has caused their seizure.

Moreover, as soon as the invasion was known, the necessary precautions were announced to the public, and all the journals have reproduced the circular of the minister.

Trichinated meat, which has been sufficiently cooked in order that the central portions attain at the least a temperature of 60° C., can be eaten without danger; for this purpose, each kilogramme of meat should be cooked about an hour.

The municipal Laboratory adds that it would be advantageous to add vinegar during the cooking.

Such are the means taken at first by the administration to oppose the importation of trichinated provisions.

It remains still to give a decision in regard to provisions stopped at the port as suspected. The inspectors being few in number, rejected a whole chest as soon as they discovered a trichina. It was hardly possible to do otherwise, unless a veritable army of microscopists was at hand, as is done for instance, in Germany, or the pork shop keepers be responsible for the sale of trichinated pork—a procedure which would set 18,000 microscopes in pursuit of the infection.

M. Pasteur, who was consulted upon the question, whether all the provisions of a chest should be seized, if only a single trichinated fragment had been encountered, replied in the affirmative, basing his decision upon the following reasons:

"It is not because I believe in a direct contamination caused by the wanderings of trichinæ from one piece to another, but, in addition to the fact that this contamination can be made through the falling of trichinated *débris* upon those which are not, the separation becomes illusory through the difficulty of effecting it. Finally, a trichinated piece may appear healthy, even after a careful examination."

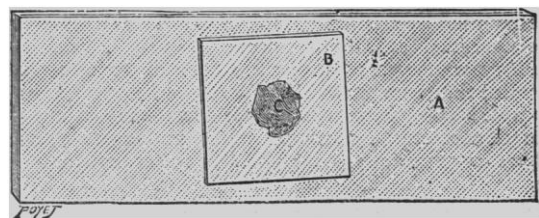


FIG. 2.—TRICHINOUS MEAT PREPARED FOR MICROSCOPICAL EXAMINATION. A. GLASS SLIDE. B. THIN GLASS COVER. C. PORTION OF TRICHINOUS MEAT.

The "*Concile de l'Hygiène et de la Salubrité*" attached to the prefecture of police has noticed the impossibility of examining under the microscope all the salted provisions exported from America. As but a small quantity chosen from each cask can be examined, the Council has formed the opinion that the only efficacious means of saving the public health should be to prohibit absolutely the importation of American salted provisions into France. And to prevent the consumption of trichinated meats already introduced, the Council, adopting the view of M. Pasteur, has expressed the opinion that the administration should destroy all the contents of casks enclosing several pieces that are known to be infected with trichina.

In this state of affairs, we believe that immediate prohibition would be the best course for the government to follow. We will recall, besides the fact that Spain, Portugal, Greece, etc., have prohibited American provisions; that Italy has prohibited all imports of pork; that Germany has interdicted the entrance of any minced pork meat coming from America, and finally that Hungary has taken like measures.

It has been objected that a prohibition would deprive the working class of a large quantity of cheap meat; another objection is the hinderance to commerce. These reasons do not appear valid to us, if there be real danger for the public health, and if there be, as we have said, and as the experiments of M. Chatin show still, living trichinæ in American hams. The danger resides especially in the use of strings preserved in brine, which enter into the composition of pig's cheese and of sausages and hashes of all kinds, such as the pork-seller delivers them, that is to say, always imperfectly cocked.

It is possible that a person may partake of trichinated meat, before its contamination has been noticed, and if a case of trichinosis be not remarked, it is only because the diagnostic of the disease is but little known, and has no positive character. Waiting until the labors of German physicians, which are but little spread in France, enlighten us on the symptoms of this affection, we deem it useful to examine under the microscope the faeces of those suffering from typhoid fever, in order to find out whether, under the cover of this malady, there is not, as often happens, a case in point of trichinæ eliminating themselves in part by this way.—*La Nature*.

TRICHINOSIS.

DR. E. C. WENDT presented to the New York Pathological Society, April 13th, specimens illustrating Trichinosis. The slides under the microscope showed muscular trichinæ in a free state. They exhibited different degrees of parasitic development, although they were all taken from the same woman. The infested muscles were obtained from a recent fatal case of the disease

which had occurred in Hoboken. For the history of the case he was indebted to Dr. W. T. Kudlich of that city. The whole course of the malady, from the initial enteric symptoms through a typhoid stage with intense muscular pains to the lethal termination, was so typical that the detailed clinical account of this case might be omitted. It should be stated, however, that shortly after the young robust wife fell ill, the husband also took to his bed with well-marked symptoms of trichinosis. In view of the present agitation of the public mind over the wholesale prohibition of American pork by the Continental powers, it might be of interest to remember that in the present instance the disease was unmistakably traced to a home product. The living parasites were used for

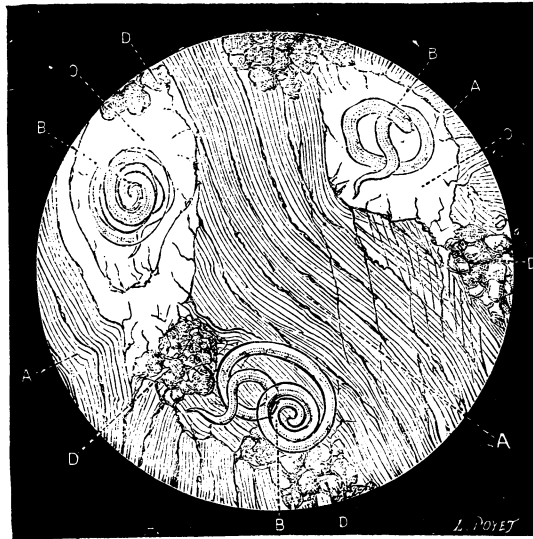


FIG. 3.—PORTION OF TRICHINOUS MEAT AS SEEN UNDER THE MICROSCOPE, MAGNIFIED 140 DIAMETERS. A. A. A. MUSCULAR FIBRES—B. B. ENCYSTED TRICHINÆ. C. C. CYSTE. D. D. D. FAT GLOBULES.

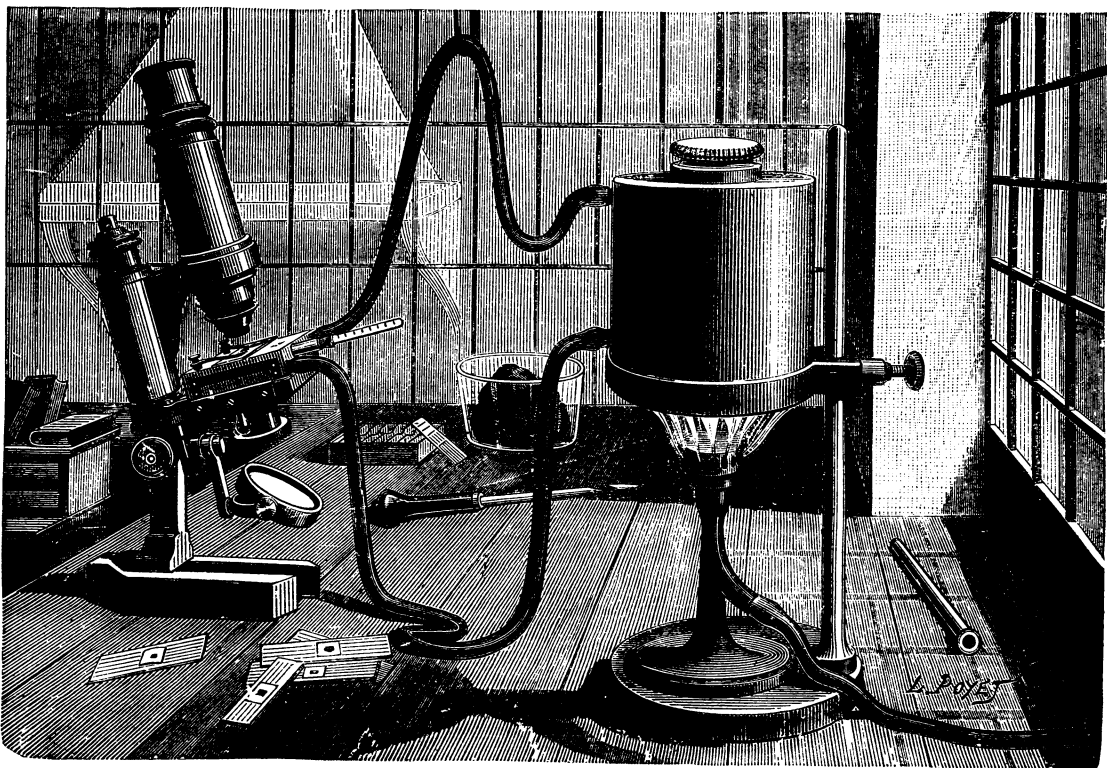


FIG. 4.—MICROSCOPE PLACED IN POSITION FOR THE EXAMINATION OF TRICHINOUS MEAT AT A TEMPERATURE OF 40° C. BY MEANS OF THE HEATING APPARATUS OF RANVIER, AS USED BY THE MUNICIPAL CHEMICAL LABORATORY AT PARIS.

purposes of experimentation; and, while entirely new facts were not elicited, a few words might be said as to the results of various trials.

Encapsulated trichinae were notoriously tenacious of life; but here were the immature, only recently emigrated parasites, still wandering about in the muscles. A few of the animals had indeed already assumed the position of a spiral coil, which was the preparatory stage of encapsulation. But the majority were either stretched out or twisted at either extremity. Little pieces of the woman's muscles were exposed to the action of cold, being several times frozen. Examination, four days afterward, found them apparently quiescent. A gradual elevation of temperature up to about 100° F. soon proved that life was not extinct, in so far, at least, as active motions can be interpreted as an indication of vitality. Ten days later the parasites were still alive. Some of the flesh was then allowed to undergo partial putrefaction. Even then the animals were living. This was thirteen days after the death of the woman.

On the day following the autopsy, some fresh muscle was teased, and, there being an abundance of living trichinae, many thus became isolated. The animals were never seen to actually creep along in a definite direction. Their movements resembled the unfurling and recoiling of a pennon. Nevertheless, a change of place was now and then fortuitously effected. Next, the parasites were subjected to the action of different reagents. Saliva produced no visible effect upon them. Dilute acids resulted in increased activity of motions. Alkalies made them sluggish. Concentrated solutions of both rapidly killed them. In carbolic acid they squirmed and writhed before dying. Glycerine, contrary to what was supposed, did not immediately kill them. Some lived for ten minutes after its addition. Finally, however, the worms became shrivelled up into almost shapeless filaments. If previously heated, however, they retained their form to a great extent.

A little of the fresh muscle was submitted to artificial digestion by being placed in a suitable fluid and exposed for twelve hours to about body heat. The muscle was in great part dissolved at the end of this time, and many free parasites were found in the liquid. But they were, if anything, less active than they had been, and, as soon as the liquid was allowed to cool, their movements ceased, to be renewed, however, on reheating the slide. A noteworthy fact, and one of great interest, was that the trichinae had unquestionably grown. But, though their size was now increased, and although indications of sex could be barely perceived, a distinct evolution into mature males and females was not obtained. It must be remarked, however, that future experiments at such artificial breeding may be more successful. Through an inadvertence the continuation of the artificial digestion was interfered with, the animals being killed by over-heating.

Portions of partially putrified muscle were placed in vials containing water, with the addition of a small proportion of glycerine, carbolic acid, and alcohol. In this liquid the parasites were maintained in a comparatively good state of preservation, showing the details of their interesting organization with satisfactory clearness. Permanent specimens, no matter what technique of preparation may be employed, were never found as perfect as recent ones made from bits of muscle thus kept. Of course, fresh would answer still better than partially decayed muscle.

Concerning the pathological condition of the infested muscles, the changes there found were the frequently described conditions of acute myositis accompanied by vitreous metamorphosis, cloudy swelling, and fatty degeneration. In some places the interfascicular hyperaemia and small-celled infiltration were beautifully seen.

The subject of trichinosis had occupied his attention for a number of years; but this was not the place to discuss the many questions which presented themselves;

only one further remark as to the diagnostic value of examining small bits of muscle removed from accessible regions in patients suspected of trichinosis. If the animals were found, of course the evidence was incontrovertible. But, *vice versa*, a conclusion could not be arrived at. This he wished to emphasize, because a contrary opinion was prevalent in some quarters. In the present fatal case of trichinosis, small bits of the deceased woman's muscles were torn from the gastrocnemius and deltoid muscles; and while some specimens had contained numerous parasites, others had been found without them. In the diaphragm, intercostal muscles, and other well-known places of predilection, every examined specimen showed abundant parasites.

Dr. Carpenter's observation at the dead-house of Bellevue Hospital had been that encysted trichinae were found more frequently in the pectoral muscles or the diaphragm than in the deltoids or the gastrocnemii.

The President (Dr. T. E. Satterthwaite), remarked that the subject of trichinosis was now of very great interest to the country at large, and we should be anxious to get all the light possible upon it. Though a vast amount of labor had been expended on the origin, clinical history, and treatment of trichinosis, we have good reason to suppose it was seldom recognized during life, and even after death would often escape notice, unless the examiner had his attention specially directed toward the possibility of its occurrence. Consequently our present statistics could not be relied upon in forming an opinion as to its prevalence. One of the points on which we needed more information was the period of incubation. This was variously placed at between ten and forty-two days; or, rather, according to our present ideas, it would take ten, but might take forty-two days for the young trichinae to appear in the muscles after the infected meat had been eaten.

Now, it was just upon this variable period that the dealers relied chiefly when they were prosecuted for selling trichinous meat. As most infected persons are Germans, who are in the habit of eating uncooked meat, more or less continuously, it is generally easy for the accused to show that other hams or sausages were eaten during this period of forty-two days, and as statements are to be found that a limited number of living trichinae have been eaten without harm, it is almost impossible to secure conviction. Dealers therefore do not ask for an examination of hogs or their products, nor are they afraid to be convicted, even should they sell trichinous meat.

Now it is particularly important to determine whether or not there is in this variable time between the ingestions of the animal and the subsequent migration of the larval form, and more experiments should be made on animals to determine it.

Then another point is important, which is, How frequently is trichinosis met with? In Europe it is said to occur in from one to two per cent. of all cadavers. In this country we have as yet no trustworthy data; at least this conclusion may be drawn from the recent report of late Assistant-Surgeon Glazier, to the U. S. Marine Service. Still we know that eight hogs out of a hundred were once found trichinous in Chicago, and though this percentage has been once exceeded in Germany, it is a large one, and invites consideration.

Especially important was, he thought, the determination whether living trichinae can really be swallowed with impunity, if in small numbers, and, if so, what quantity is necessary for infection; whether such trichinae be the larval or fecundated forms; and whether emetics or purgatives were not afterward employed to expel them, as in this latter case it is reasonable to suppose they might have been removed without harm to the individual.

The President further remarked that there were now no specially appointed officials who made it their duty to inspect meat, as was formerly done. A diminished appropriation led to the suspension of this work.

BOOKS RECEIVED.

ISLAND LIFE; OR, THE PHENOMENA AND CAUSES OF INSULAR FAUNAS AND FLORAS, including a revision and attempted solution of the Problem of Geological Climates, by ALFRED RUSSEL WALLACE.—Harper Brothers, New York, 1881.

The authors of the theory of evolution undoubtedly feel the responsibility involved in revolutionizing one of the most important branches of Science; it is therefore natural to find both Dr. Darwin and Mr. Wallace devoting their best energies to aid evolutionists in placing "the theory" upon a sound basis.

Perhaps one of the strongest arguments that can be advanced in favor of evolution is the fact, that it offers a key for solving difficulties encountered by naturalists, which hitherto were inexplicable, or accounted for by a line of reasoning now shown to be erroneous.

The distribution of animal life upon the globe, which forms the subject of the present work, exhibits in a strong light some of the fallacies of the older naturalists, and the value of the theory of evolution in interpreting the work of Nature.

The old school of naturalists explained the geographical distribution of animals by believing, that "the several species of animals and plants" were special creations, and consequently assumed, that every animal was *exactly* adapted to the climate and surroundings amid which it lived, and that the only, or, at all events, the chief reason why it did not inhabit any other country was that the climate or general condition of that country was not suitable to it.

In the present state of knowledge respecting the fauna and flora of the whole world, it is not difficult to prove that other reasons must be found to account for the phenomena met with in the general distribution of animal life, and Mr. Wallace makes the case quite clear by giving some striking illustrations.

It is true that hot climates differ from cold ones in all their organic forms, but its effects are by no means constant, but are irregular and uncertain, and the contrast does not bear any proportion to the difference of temperature.

For instance, between frigid Canada and sub-tropical Florida there are less marked differences in the animal productions than between Florida and Cuba or Yucatan, which are much more alike in climate and so much nearer together. So the differences between the birds and quadrupeds of temperate Tasmania and tropical North Australia are slight and unimportant as compared with the enormous differences we find when we pass from the latter country to equally tropical Java, and if we compare corresponding portions of different continents, we find no indications that the almost perfect similarity and general conditions have any tendency to produce similarity in the animal world. The equatorial parts of Brazil and of the west coast of Africa are almost identical in climate and in luxuriance of vegetation, but their animal life is totally diverse. In the former we have tapirs, sloths, and prehensile-tailed monkeys; in the latter, elephants, antelopes, and man-like apes; while among birds, the toucans, chatterers and humming-birds of Brazil, are replaced by the plantation-eaters, bee-eaters and sun birds of Africa. Parts of South-temperate America, South Africa and South Australia correspond closely in climate; yet the birds and quadrupeds of these three districts are as completely unlike each other as those of any parts of the world that can be named. The present work, although complete in itself, is one of a series prepared by Mr. Wallace to account for the geographical distribution of animal life, by the theory of evolution, and being the result of many years study by one of the most eminent of living naturalists, will command the attention of all who desire to find a true solution of the subject.

Some of the most remarkable and interesting facts in

the distributions and affinities of organic forms are presented by *islands* in relation to each other and to the surrounding continents. Yet their full importance in connection with the history of the earth and its inhabitants has hardly yet been recognized; and in order to direct the attention of naturalists to this most promising field of research, Mr. Wallace has restricted himself in the volume now before us, to the elucidations of some of the problems there presented to us.

Such then is the scope and purpose of "Island Life, or the Phenomena and Causes of Insular Faunas and Floras," involving the study of a class of subjects embracing in their very nature the visible outcome and residual product of the whole past history of the earth. There is no royal road to the acquisition of knowledge, and to prepare those readers who have not been trained in such studies to appreciate the conclusions drawn, Mr. Wallace in the first eight chapters devotes much space to the explanation of the mode of distribution, variation, modification and dispersal of species and groups, illustrated by facts and examples; of the true nature of geological change as affecting continents and islands; of changes of climates, their nature, causes and effects; of the duration of geological time and the rate of organic development.

The aim of Mr. Wallace in this work is the development of a clear and definite theory, and its application to the solution of a number of biological problems. That theory may be briefly stated as follows: That the distribution of the various species and groups of living things over the earth's surface, and their aggregation in definite assemblages in certain areas, are the direct result and outcome of a complex set of causes, which may be grouped as "*biological*" and "*physical*." The *biological* causes are mainly of two kinds—first, the constant tendency of all organisms to increase in numbers, and to occupy a wider area, and their various powers of dispersion and migration through which, when unchecked, they are enabled to spread widely over the globe; and secondly, those laws of evolution and extinction which determine the manner in which groups of organisms arise and grow, reach their maximum, and then dwindle away, often breaking up into separate portions which long survive in very remote regions. The *physical* causes are mainly of two kinds. We have, first, the geographical changes which at one time isolate a whole fauna and flora, at another time lead to their dispersal and intermixture with adjacent faunas and floras, and here Mr. Wallace endeavored to ascertain and define the exact nature and extent of these changes, and to determine the question of the general stability or instability of continents and oceans; in the second place he also investigated the exact nature, extent and frequency of the changes of climate which have occurred in various parts of the earth, because, as it may be supposed, such changes are among the most powerful agents in causing the dispersal and extinction of plants and animals. The importance attached to the geological climates and their causes, induced Mr. Wallace to discuss this branch of the subject at some length, and the most recent investigations of geologists, physicists and explorers were fully called into requisition.

Mr. Wallace next applied these facts and theories to explain the phenomena presented by the floras and faunas of the chief islands of the globe, which are classified, in accordance with their physical origin, in three groups or classes, each of which is shown to exhibit certain well marked biological features.

Mr. Wallace then defines what are called "*areas of distribution*," as applied to species, genera and families, and, taking British mammals and land birds, he follows them over the whole area they inhabit, and obtains a foundation for the establishment of "*zoological regions*," and a clear insight is formed of their character as dis-

inct from the usual geographical divisions of the globe.

All these facts are then shown by Mr. Wallace to be a necessary result of the "*law of evolution*." The nature and amount of "*variation*" are exhibited by a number of curious examples; the origin, growth and decay of species and genera are traced, and all the interesting phenomena of isolated groups and discontinuous generic and specific areas are shown to follow as logical consequences.

The remaining subjects discussed by Mr. Wallace carry him into the realm of fierce controversies, and relate to theories involving problems awaiting further investigations for their solution. One of these subjects—The Position of the Great Oceans and Chief Land Areas—is dealt decisively by Mr. Wallace, who claims that "on the whole they have remained unchanged throughout geological time." This declaration of the author has been already challenged, and we shall watch with interest if Mr. Wallace is capable of maintaining his position on this subject.

Perhaps the most valuable part of this work is the discussion of the question of geological time as bearing on the development of the organic world, leading to an investigation as to the exact nature of past changes of climate.

In answer to those who may consider the subject last spoken of as unsuited to such a work as the present, the author claims that, although many of the causes introduced are far too complex in their combined action to enable us to follow them out in the case of any one species, yet their broad results are clearly recognizable, and we are thus enabled to study more completely every detail and every anomaly in the distribution of living things, in the firm conviction that by doing so we shall obtain a fuller and clearer insight into the causes of nature, and with increased confidence that the "mighty maze" of Being we see everywhere around us is "not without a plan."

No person should offer an opinion on the "theory of evolution" who has not studied this work of Mr. Wallace, for it forms an essential part of the literature of the subject.

NOTE IN REGARD TO "PRIMITIVE DESIRES."

In a communication published in an earlier number of "SCIENCE," (No. 29, Jan. 15, 1881) Dr. Clevenger, of Chicago, discusses the relation existing between the desire for food, and the desires connected with the multiplication of the species. He appears to draw the conclusion that hunger is the primitive desire.

There are some observations made by alienists, which strongly tend to confirm Dr. Clevenger's theory.

It is well known that under pathological circumstances, relations obliterated in higher development and absent in health, return and simulate conditions found in lower and even in primitive forms.

An instance of this is the *pica* or morbid appetite of pregnant women, and hysterical girls for chalk, slate pencil and other articles of an earthy nature. To some extent, this has been claimed to constitute a sort of reversion to the oviparous ancestry, which like the birds of our day sought the calcareous material required for the shell structure in their food (?)

There are forms of mental perversion, properly classed under the head of the degenerative mental states, with which a close relation between the hunger appetite and sexual appetite becomes manifest.

Under the heading "Wollust,"—Mordlust-Anthropophagie" Krafft. Ebing describes a form of sexual perversion, where the sufferer fails to find gratification unless he or she can bite, eat, murder or mutilate the mate. He refers to the old Hindoo myth of *Çiva* and *Durgā* as showing that such observations in the sexual sphere were not unknown to the ancient races.

He gives an instance, where after the act, the ravisher butchered his victim, and would have eaten a piece of the viscera, another where the criminal drank the blood and ate the heart, still another where certain parts of the body were cooked and eaten.*

In reference to this question, Dr. Clevenger some time ago sent me the following interesting letter, which, anticipating much that I should otherwise say, may find a place here.

CHICAGO, February 17, 1881.

Dear Doctor:

The suggestions that you made, in a recent note to me, on the extension of the Hunger Theory to Man, are of too much value not to be published. Professor E. D. Cope kindly sent me the reprint of an article of his entitled "The Origin of the Will" which appeared in the *Penn Monthly*, for June, 1877, wherein the Professor takes the ground that Hunger is the primitive desire. "The movement of the *Amœba* in engulfing a *Diatom* in its jelly is as much designed, as the diplomacy of the statesman or the investigations of the student, and the motive may be the same in all three cases; viz.: hunger" (p. 438). "In the lowest animal the first movement was doubtless a mere discharge of force; but the first designed action, the appropriation of food, was due to a sense of want or hunger, which is a form of pain. This was followed by gratification, a pleasure, the memory of which constituted a motive for a more evidently designed act, viz.: pursuit" (p. 446). I am rather inclined to reverse the conception of the unconscious being derived from the conscious act and conclude that the pain of hunger is akin to the desire barium may have for sulphuric acid or any molecule may have for another.

Yours truly,

S. V. CLEVINGER.

I cannot see the necessity of considering "the movement of the *Amœba*, as designed as the diplomacy of the statesman etc." It is either a truism according to one reading, or utterly erroneous—according to another. If "as designed" in the above means—based on the same broad summation of registered impressions potent in intellectual activity, I must say that due regards have not been paid to very fundamental facts in framing the clause criticized.

E. C. SPITZKA.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

To the Editor of "SCIENCE.":

In reply to the remarks made by Mr. Morris about my communication to you (No. 43), I would like to say a few words.

In the first place I beg to enter a protest against the gentleman's suggestion with which he prefaces his reply, to wit:

"The main difficulty seems to be that I have gone counter to certain authors whom they are disposed to consider as authorities," meaning Prof. Dolbear and the writer. As to this objection, so often raised at the present moment, it seems to me that it is only applicable in case the authority is adduced in place of an argument, or in order to fortify it. As a rule, men of an independent turn of mind do not believe or accept theories because this or that authority has advanced them, but because they are plausible to them—perhaps only as long as they do not hear of any other in regard to the subject. But, if they should adopt another theory in place of one formerly held, it is certainly not on account of the fact that it has emanated from a certain authority, but because their mode of thinking and working out problems agrees with that which originated the theory, *i. e.* the authority's.

Since I have nowhere in my letter quoted any authority specifically, gathering my arguments from the works of those men whose writings are most congenial to my frame of mind, and from them weaving the net of my intellectual product with an occasional glimpse from my

* Ueber gewisse Anomalien des Geschlechts-triebes. Von Kraft-Ebing, Arch f. Psychiatrie VII.

own brains, I would seem to be justified in resenting this peculiar argumentation.

I might, in view of this unjust criticism, retort that perhaps it is altogether a better way to rely on an occasional authority, a good number of whom are towering up high above the sea of opinions as trustworthy beacons of light, than to steer along without looking up to them as guides now and then, and perhaps be wrecked on some unknown shore or unsuspected reef. The tendency to scoff at authorities because they are authorities, is just as pernicious as that to put faith in them for this same reason only.

As to my somewhat confused idea of heat, of which Mr. Morris takes the liberty to speak, I confess that I have supposed he understood the difference between radiant and conducted heat,* and he also was aware what was understood by universal consent with the expression "work." I should not have undertaken this discussion on physical subjects had I not been convinced that the terms to be used were agreed upon. However, Mr. Morris seems to be in a fair way to come down to the very last questions about the nature of motion and matter.

As to "*latent heat*," if Mr. Morris, Sir Wm. Thompson,* and many others persist in calling heat that which is not heat, they are at liberty to do so; yet they are wrong.

This I have conclusively shown, and Mr. Morris has not even tried to argue on it. Nor has he thought necessary to argue in regard to my remarks on his erroneous conception of the action of gravity. He only reiterates his assertion that the energy with which a body weighing a million pounds would fall on a body weighing one pound is the same. In order to prove this he says "we must add," and add and add, and then *one* will develop just as much energy as a *million*!

It seems futile to argue longer on a proposition that is in direct conflict with Newton's first law. If Mr. Morris has no room for the latter in his Universe, I must respectfully decline to enter it, preferring to stay outside of it in company with Sir Isaac and various others equally sound and reliable.

If Mr. Morris says motion is motion and cannot possibly become anything else, he is certainly right; but he forgets that there are certain *forces* for which we have as yet not been able to *prove* conclusively that they *are* motions. Of course, Mr. Morris has told us how he conceives of this relation between gravity and molecular motion, so called. (And there is cohesion and magnetism yet to account for.) But his explanations are wide away from the mark, which lies in an entirely different direction.

The combined action of all the radiant energy emanating from an infinite number of celestial bodies is transmitted in every direction through the Universe, and by oscillations, vibrations, and undulations of the attenuated matter (*not ether*—there is no ether!) which fills the interstellar spaces. In striking the surface of the various orbs, great and small, it exerts a uniform pressure, gravity.

Respectfully,

GEO. W. RACHEL, M. D.

NEW YORK, May 30, 1881.

THE "*Astronomische Nachrichten*."—It is announced that after the termination of the current volume, by authority of the Prussian Government, a new arrangement for the management of this journal will take effect. It will be edited by Prof. A. Krueger, the director of the Observatory at Kiel, in co-operation with the president of the "*Astronomische Gesellschaft*," of which association it will become a recognized organ.

* SCIENCE, Vol. I. p. 245. L. 24 fr. below.

** Admits that *t* is not heat, but favors the expression for convenience.

To the Editor of SCIENCE:

I can scarcely permit such curious statements as made by Prof. A. E. Dolbear, to pass unnoticed. In "SCIENCE" No. 43, he says:—"The decaying stump that shines by night, has a temperature not appreciably higher than surrounding objects." Can it be possible that he compares the state of matter in ancient wood, with the inconceivably rare gas whence Neptune was formed? Several cubic miles of it only weighed a grain, as has been proven by Helmholtz. It was in dissociation, no two atoms touched, therefore we assert with reason that it was absolutely cold and dark. The atoms in the stump had been in intimate association; indeed their organization was once so complex as to have been endowed with that most mysterious of all entities—LIFE!

When decaying, it was surrendering the force whose work organized it, and its faint luminosity was a portion thereof. The light was a result of preceding work, but in interstellar space, where atoms were yards apart, no previous work had been performed, and no force evolved whether heat, light, or any other save gravity and the slowest radial motion possible.

EDGAR L. LARKIN.

NEW WINDSOR OBS., Ill., June 13, 1881.

REPLY TO DR. J. J. MASON'S LETTER.

The writer of the review referred to, states that notwithstanding the construction which Dr. J. J. Mason now desires to see placed upon his words, the most careful reader would fail to draw any other conclusion from Dr. Mason's article, than that it was written in support of the theory that large cells are motor, and that sensory cells are small. It is true as Dr. Mason states that the sentence just preceding the one quoted in his letter refers specifically to the spinal cord of the turtle. But it is none the less true that the whole paragraph polemizes against a statement of Stieda's that the observations "have great weight against the conclusion that only the large nerve cells are connected with motor fibres," as not representing the ordinary view. In the earlier part of his article, Dr. Mason indeed goes so far as to question the statements of our best cerebral anatomists that certain very large cells are connected with the auditory, *i. e.* a sensory nerve, and this in obedience to the same theoretical bias which is manifested a few lines further on in this wise. "I would suggest, however, to those who may feel disposed to regard these cells (large cells of auditory nucleus and oblongata) as connected with the sense of hearing, that such a view involves giving to this apparatus in its central portion, a structure almost identical with one universally admitted to be motor, like, for example, that concerned in raising the lower jaw; whereas in the central structures for vision and olfaction *the cells are all very small*." (Italics are own.) What other than the size of the cells and their nuclei does Dr. Mason refer to when he speaks of a "structure universally admitted to be motor?" Especially when it is borne in mind that immediately after he claims that all sensory cells are very small. In view of all this Dr. Mason's statement that no such claims as the one imputed to him by the reviewer had ever been made by him "in any form by hint, inference or otherwise," must have been penned in strange forgetfulness of what he has laid down in his published article. The reviewer can only interpret the remonstrance as an abandonment by Dr. Mason of his previous position. Every statement in the quoted paragraphs is simply erroneous, and to bring Dr. Mason face to face with facts that he has questioned, the reviewer refers to Dr. Mason's statement that the cells connected with vision "*are very small*," and the reliable findings of Professor Packard, who happened to state that in the locust these cells are very large in relation to the other cells of the nervous system.

R. C. S

THE CONSERVATION OF ELECTRICITY.

The following is from the preface to "Elementary Lessons in Electricity and Magnetism," by SILVANUS P. THOMPSON, now in the press.

"The theory of electricity adopted throughout is that electricity, whatever its nature, is *one*, not *two*. That this electricity, whatever it may prove to be, is not *matter*, and *energy*; that it resembles both matter and energy in one respect, however, in that it can neither be created nor destroyed. The doctrine of the *Conservation of Matter*, established a century ago by Lavoisier, teaches us that we can never destroy nor create matter, though we can alter its distribution and its forms and combinations in innumerable ways. The doctrine of the *Conservation of Energy* which has been built up by Helmholtz, Thomson, Joule, and Mayer during the last half century teaches us that we can neither create nor destroy energy, though we may change it from one form to another, causing it to appear as the energy of moving bodies, as the energy of heat, or as the static energy of a body which has been lifted against gravity or some other attracting force into a position whence it can run down, and where it has the potentiality of doing work. So, also, the doctrine of the *Conservation of Electricity*, which now is growing into shape, but here first enunciated under this name, teaches us that we can neither create nor destroy electricity, though we may alter its distribution—may make *more* to appear at one place and *less* at another—may change it from the condition of rest to that of motion, or may cause it to spin round in whirlpools or vortices which themselves can attract or repel other vortices. According to this view all our electrical machines and batteries are merely instruments for altering the distribution of electricity by moving some of it from one place to another, or for causing electricity when heaped up in one place to do work in returning to its former level distribution. Throughout these lessons the attempt has been made to state the facts of the science in language consonant with this view; but rather to lead the young student to this as the result of his study than to insist upon it dogmatically at the outset."

A WATER CARRYING TORTOISE.

At a meeting of the Academy of Sciences the other evening, a very fine specimen of the desert land tortoise, from Cajon Pass, San Bernardino county, California, was received. The specimen had been carefully prepared, and was as large as an ordinary bucket. The tortoise is a native of the arid region of California and Arizona, and Prof. E. T. Cox, who was present, related a curious circumstance connected with it.

He found on dissecting one of them that it carried on each side a membrane, attached to the inner portion of the shell, in which was about a pint of clear water, the whole amount being about a quart. He was of the opinion that this water was derived from the secretions of the giant barrel cactus, on which the tortoise feeds. This cactus contains a great deal of water.

The tortoise is found in sections of country where there is no water, and where there is no vegetation but the cactus. A traveler suffering from thirst could, in an emergency, supply himself with water by killing a tortoise. They are highly prized by Mexicans, who make from them a delicious soup. The foxes of the desert attack the tortoise and finally overcome them by dragging them at times for miles.

B. B. Redding said he would try to obtain a live one for the Academy in order that its habits and peculiarities may be carefully observed and noted. He instanced being on the Gallapagos islands in 1849 and assisting in the capture of 92 land tortoises, varying from 450 to 600 lbs. in weight, which the vessel brought to San Francisco and sold for more money than the whole cargo of lumber netted at that time. They were two months on board the vessel, yet ate nothing and those killed had in them considerable quantities of pure water. They live on the high lava rocks, which rise as mountains on the island, where there are no springs or streams, and the only dependence of animal life for water is necessarily upon the irregular and uncertain rain showers.

It may be mentioned that the tortoise are of different species, though they may have the same habit in respect of carrying water. The famous edible species of the coasts of the Pacific and Indies, of which the headquarters is at Gallapagos islands, is the *Testudo Indica*. They grow to five, six, and even seven hundred pounds or more. Those found in this State are smaller and are the *Agassii* species first described some years ago by Dr. J. G. Cooper, if we recollect aright. Those Mr. Redding describes from the Gallapagos were offered water while on the ship but refused it. Yet when killed they all contained water. The place they inhabit is a dry one, lacking water. It may be that they go to the high places and obtain it from the vegetation, the same as our species does.

DALTONISM.—A Belgian Commission is making investigations on Daltonism. Their method of procedure is as follows:—On a table exposed to the bright sunlight are placed skeins of wool varying in color. The subject under examination is given, for example, a green colored one and he is told to select another of the same color. If he does so without hesitation, he is not affected with Daltonism, but he is still subjected to other trials, as for instance, the observation of colored signals at a distance. This applies especially to those employed on railways.

NEW RECORDING APPARATUS OF MOVEMENTS.—About twenty years ago M. Marey proposed to inscribe the different movements of living animals by means of a lever, as light as possible, and protected from every cause tending to set it in vibration. Since this epoch a considerable number of operations have been accomplished by the aid of this instrument; thus, the phenomena of the circulation of the blood, of respiration and of the movements of the heart have, in the employment of this method, been conclusively solved. Nevertheless one objection has been raised against these instruments: in the sometimes exceedingly complicated tracings of physiological acts, the proper movements of the lever have increased the real curve of the movement which is to be inscribed. M. Marey has therefore invented and presented to the Academy a new inscriptive apparatus, the lever being reduced, which gives microscopic inscriptions, and thus can inscribe rapid movements with the greatest precision. The tracings of this instrument, which may be produced by the vibrations of the voice, or by the breath, are afterwards enlarged by projection and reduced to the necessary size. The microscopic inscription given by the new apparatus extends to an almost indefinite degree phenomena susceptible of registration.

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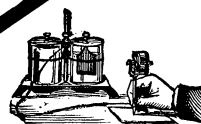
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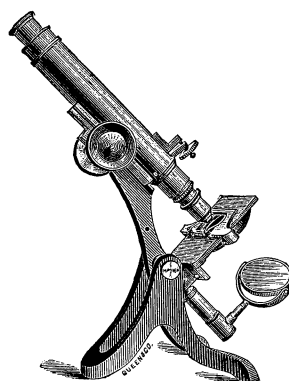
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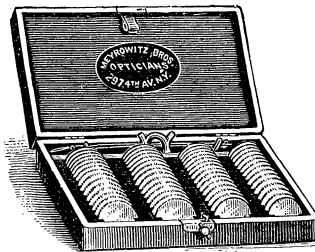
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